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TI Hot rolled ultrathin ferritic steel sheets having high impact resistance suitable for automobiles and their preparation
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AB The title steel sheets containing C 0.0001-0.02; Si 0.01-2.0; Mn 0.1-3.0; P 0.01-0.15; S ≤0.010; Al 0.001-0.05; and optionally (1) B 0.0001-0.01, Ti 0.001-2.0, and/or Nb 0.0005-1.0; and (2) Cr 0.001-2.0, Ni 0.001-2.0, Mo 0.001-2.0, and/or Cu 0.001-2.0 weight% have ferritic single phase (crystal grain size number ≥12), surface oxide layers of thickness ≤3μm, and sheet thickness <1.2mm. Steels of the compns. are treated by the following steps to give the title sheets; heating at 900-1250°, rough rolling to give sheet bars, joining the sheet bars with another sheet bars which have been previously formed, finish rolling by rolling rate ≥900 m/min, by finishing at a temperature between Ar3 transformation point and (Ar3 + 50°), and by ≥95% draft to give sheet thickness <1.2 mm, (within 0.5s) cooling to ≤450° by cooling rate ≥50°/s, and coiling. The sheets show excellent hole enlargement property.

Notes:
1. Untranslatable words are replaced with asterisks (****).
2. Texts in the figures are not translated and shown as it is.

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Dictionary: Last updated 09/07/2007 / Priority: 1. Electronic engineering / 2. Chemistry / 3. JIS (Japan Industrial Standards) term

FULL CONTENTS

[Claim(s)]
[Claim 1] C:0.0001 - 0.02wt% and Si:0.01 - 2.0 wt%, Mn: 0.1 - 3.0 wt%, and P:0.01 - 0.15wt %, Less than S:0.010 wt% and aluminum:0.001 - 0.05wt% are contained, the remainder consists of Fe and unescapable impurities, and a metal texture is a with a ferritic grain size numbers of 12 or more ferrite single phase organization. Ultra-thin hot rolled sheet steel which is excellent in the shock resistance whose board thickness the thickness of a surface layer of oxides is 3 micrometers or less, and is under 1.2 mm.
[Claim 2] C:0.0001 - 0.02wt% and Si:0.01 - 2.0 wt%, Mn: 0.1 - 3.0 wt%, and P:0.01 - 0.15wt %, Less than S:0.010 wt% and aluminum:0.001 - 0.05wt% are included. And B:0.0001 - 0.01wt% and Ti:0.001 - 2.0 wt%, Any one sort chosen from Nb:0.0005 - 1.0 wt% or two sorts or more are contained, the remainder consists of Fe and unescapable impurities, and a metal texture is a with a ferritic grain size numbers of 12 or more ferrite single phase organization. The thickness of a surface layer of oxides is 3 micrometers or less, and board thickness is 1.2mm. Ultra-thin hot rolled sheet steel which is excellent in the shock resistance which is the following.
[Claim 3] C:0.0001 - 0.02wt% and Si:0.01 - 2.0 wt%, Mn: 0.1 - 3.0 wt%, and P:0.01 - 0.15wt %, Less than S:0.010 wt% and aluminum:0.001 - 0.05wt% are included. And Cr:0.001 - 2.0 wt% and nickel:0.001 - 2.0 wt%, Any one sort chosen from Cu:0.001 - 2.0 wt% or two sorts or more are contained Mo:0.001 - 2.0 wt%. It consists of Fe and unescapable impurities, and a metal texture is a with a ferritic grain size numbers of 12 or more ferrite single phase organization, the thickness of a surface layer of oxides is 3 micrometers or less, and the board thickness of the remainder is 1.2mm. Ultra-thin hot rolled sheet steel which is excellent in the shock resistance which is the following.
[Claim 4] C:0.0001 - 0.02wt% and Si:0.01 - 2.0 wt%, Mn: 0.1 - 3.0 wt%, and P:0.01 - 0.15wt %, Less than S:0.010 wt% and aluminum:0.001 - 0.05wt% are included. And B:0.0001 - 0.01wt% and Ti:0.001

- 2.0 wt%, Any one sort chosen from Nb:0.0005 - 1.0 wt% or two sorts or more are contained. Furthermore, Cr:0.001 - 2.0 wt% and nickel:0.001 - 2.0 wt%, Any one sort chosen from Cu:0.001 - 2.0 wt% or two sorts or more are contained Mo:0.001 - 2.0 wt%. It consists of Fe and unescapable impurities, and a metal texture is a with a ferritic grain size numbers of 12 or more ferrite single phase organization, the thickness of a surface layer of oxides is 3 micrometers or less, and the board thickness of the remainder is 1.2mm. Ultra-thin hot rolled sheet steel which is excellent in the shock resistance which is the following.

[Claim 5] In manufacturing the ultra-thin hot rolled sheet steel of a description in Claim 1 - any 1 clause of four The steel stock of the component composition indicated in each clause is heated at 900-1250 degrees C. It joins to a sheet bar, and nothing and the sheet bar which subsequently precedes this sheet bar by rough rolling. Rolling speed 900 m/min They are 1.2mm of board thickness above, carrying out lubrication on rolling-complete-temperature Ar3 transformation point - (+50 degrees C of Ar3 transformation points), and the conditions of 95% or more of rolling reduction. Finish rolling is carried out to the following. After that 0.5 It is the cooling rate of 50 degrees C/sec within a second. The manufacture method of the ultra-thin hot rolled sheet steel characterized by cooling below to 450 ** above, and rolling round in a coil.

[Detailed Description of the Invention]

[0001]

[Field of the Invention] If this invention was mainly used for the purpose for spending of the parts for cars etc., and it should collide especially while the car ran, it relates to the ultra-thin hot rolled sheet steel of less than 1.2mm of board thickness suitably used as a material of the part asked for the outstanding shock resistance, and its manufacture method.

[0002]

[Description of the Prior Art] It makes for the opportunity of earth environment preservation to have grown recently into a background, and is CO2 from a car. The weight saving of the automobile body is called for as part [the amount of discharge] of reduction. It is thought that reduction of the board thickness by high-intensity-izing of a steel plate is effective as the method of such a weight saving. Furthermore, if are based on the design philosophy of the latest automobile body, and it should collide not only high-intensity-izing of a mere steel plate but during a run, it will set. When it changes with the steel plate excellent in shock resistance, i.e., a high strain rate, it is observed as what development of the steel plate which has high deformation resistance contributes effective in realization of the weight saving of the body while bringing about improvement in the safety of a car. On the other hand, it changes to the cold rolled sheet steel used from the former by the cost cut inclination of a use material in recent years, and they are 1.2mm of hot-rolled-sheet-steel division board thickness. The tendency which is going to adopt the ultra-thin hot rolled sheet steel of the following is increasing. From such a situation, development is desired for the ultra-thin hot rolled

sheet steel which is excellent in shock resistance from the improvement in safety of a car, and a viewpoint of a cost cut.

[0003] by the way, solid solution strengthening by quality-of-the-material strengthening of the steel plate for cars mainly adding conventionally Si, Mn, and the replaced type element P, in a ferrite single phase organization or Nb, and Ti ** -- the method of depending on precipitation strengthening by adding the said carbon nitride formation element was common. For example, in JP,S56-139654,A, the steel plate which was made to contain Ti and Nb in order to improve workability and aging nature to super-low carbon steel, was made to contain strengthening components, such as P, further in the range which does not injure workability, and attained high intensity-ization is proposed. Moreover, the proposal of the method which attains high intensity-ization by addition of Si to super-low carbon steel is made by JP,S59-193221,A, for example. <BR [0004]> However, in high intensity-ization of the steel plate in such a method, even if it can decrease the board thickness of an automobile body to some extent, the above-mentioned shock resistance is not improved in essence. Because, in these proposals, a strain rate is the yield strength or tensile strength which is the index of steel plate intensity 10-3 to 10-2 (s-1) although asked only what is called based on a very late static valuation method The strain rates which took into consideration the safety at the time of a collision rather than such static intensity in the design of the actual automobile body are 10-104 (s-1). It is because the direction of the intensity what is called based on a dynamic valuation method accompanied by shocking modification becomes important. Therefore, each conventional proposal which is developed only paying attention to static intensity and which was mentioned above had the problem that there was no fundamental index ******, to the weight saving of the automobile body. In addition, 2 phase organization steel plate of martensite and a ferrite is proposed by JP,7-90482,A from a viewpoint of raising shock resistance. However, this technology had the problem of being hard to apply, in 2 phase organization steel in the portion which hole expansion property is bad and needs stretch flanging.

[0005] The general hot-rolling method currently performed from the former on the other hand in order to manufacture hot rolled sheet steel is 100-mm-thick - 300mm. It was what carries out rough rolling of the slab to 20mm - 60mm in thickness, and carries out finish rolling to 10mm or less in thickness further after that. By this hot-rolling method, it is 1.2mm. In order to roll to the last board thickness of the following, it had not resulted, by the time it not only makes operation difficult, but caused deterioration of product quality by a factor which is described below and put in practical use. That is, if board thickness becomes ultra-thin, during rolling, the temperature fall of the surface part of a steel plate and an end will become large, and it will become very difficult especially to perform finish rolling in a predetermined temperature span (three or more transformation points of Ar(s)) covering the full length of a steel plate and full. Although what is necessary is just to gather rolling speed in order to secure this finish rolling temperature, in control of form becoming difficult, rolling load serves as size. Therefore, the method for controlling the form of ultra-thin hot rolled sheet steel is proposed by JP,63-260604,A, for example. After this method rolls the point of rolled material covering predetermined length thicker than finish board thickness, it is thinned to finish board thickness by gauge change between **, and rolls a succession part.

[0006]
[Problem to be solved by the invention] However, by the method of the indication to said JP,63-260604,A, the yield omission by an off-gage could also be 6%, and there was a problem that a cost hike was unavoidable. Moreover, in rolling of ultra-thin hot rolled sheet steel, since the rolling reduction of finish rolling becomes large, it becomes difficult to make a reduction roll bite. If board thickness after rough rolling is made thin in order [this] to bite and to avoid a poor lump, the temperature drop of the steel plate in finish rolling will become still larger, and reservation of finish rolling temperature will become difficult. Moreover, if rolling reduction of the head portion of a steel plate is made small at the time of finish rolling and board thickness is thickened, the yield of a product will fall. in addition, [with the common hot-rolling board of board thickness / technology / which makes a ferrite grain size fine] It is the surface by there being some proposals from the former, for example, starting quenching to JP,H7-258796,A in the end of finishing hot-rolling. The method of controlling the surface up to 100 micrometers in particle diameter of 10 micrometers or less is indicated. However, quenching under this hot-rolling is disadvantageous to stabilize and control hot-rolling finish temperature to a predetermined temperature span, and is also holding the difficulty on equipment arrangement. There was a problem that it was impossible to carry out grain refining of it to 12 or more grain size numbers over total board thickness moreover even if it applies such a method to an ultra-thin steel plate. As explained above, at a Prior art, they are 1.2mm of board thickness. There was a problem that the ultra-thin hot rolled sheet steel of the following could not be manufactured inexpensive without causing a yield fall. Furthermore, there was a problem that the ultra-thin hot rolled sheet steel equipped with shock resistance by such a Prior art at the time mentioned above could not be manufactured inexpensive.
[0007] Then, the purposes of this invention are 1.2mm of board thickness which is excellent in ****-proof under a high strain rate without reducing hole expansion property. It is in developing the ultra-thin hot rolled sheet steel of the following. Moreover, other purposes of this invention are 1.2mm of board thickness which is excellent in ****-proof under a high strain rate without reducing hole expansion property. It is in establishing the manufacturing technology for manufacturing inexpensive the ultra-thin hot rolled sheet steel of the following with the sufficient yield. The concrete purpose of this invention has 75% or more of a rate of hole expanding, and are static-dynamic ratio = dynamic yield stress (yield stress in a strain rate 103 (s-1)) / static yield stress (the static-dynamic ratio defined by the strain rate 10-3 (s-1) is 1.6 [it is above and]). The absorbed energy to the 30% distortion at the time of high strain rate modification (strain rate 103 (s-1)) is 200 MJ/m3. The absorbed energy to the above or a fracture is 320 MJ/m3. The board thickness which it is above is 1.2mm. It is in proposing the ultra-thin hot rolled sheet steel and manufacturing technology of the following.
[0008]
[Means for solving problem] [inventors] by controlling chemical composition, the hot-rolling method and its condition, the cooling conditions after rolling, rolling-up conditions, etc. proper as a result of inquiring wholeheartedly towards realization of the purpose of upper ** 1.2mm of board thickness The organization of the ultra-thin hot rolled sheet steel of the following was made into with a grain size

number numbers of 12 or more of a ferrite fine grain ferrite single phase, it became possible to acquire the suitable surface description for forming processing, and the knowledge of the above-mentioned technical problem being solvable was carried out. That is, this invention considers the following contents as summary composition.

[0009] (1) C:0.0001 - 0.02wt% and Si:0.01 - 2.0 wt%, Mn: 0.1 - 3.0 wt% P:0.01 - 0.15wt%, S: Less than 0.010 wt% aluminum:0.001 - 0.05wt% is contained, the remainder consists of Fe and unescapable impurities, and a metal texture is a with a ferritic grain size numbers of 12 or more ferrite single phase organization. Ultra-thin hot rolled sheet steel which is excellent in the shock resistance whose board thickness the thickness of a surface layer of oxides is 3 micrometers or less, and is under 1.2 mm.

[0010] (2) C:0.0001 - 0.02wt% and Si:0.01 - 2.0 wt%, Mn: 0.1 - 3.0 wt% P:0.01 - 0.15wt%, S: Less than 0.010 wt% aluminum:0.001 - 0.05wt% is included. And B:0.0001 - 0.01wt% and Ti:0.001 - 2.0 wt%, Any one sort chosen from Nb:0.0005 - 1.0 wt% or two sorts or more are contained, the remainder consists of Fe and unescapable impurities, and a metal texture is a with a ferritic grain size numbers of 12 or more ferrite single phase organization. The thickness of a surface layer of oxides is 3 micrometers or less, and board thickness is 1.2mm. Ultra-thin hot rolled sheet steel which is excellent in the shock resistance which is the following.

[0011] (3) C:0.0001 - 0.02wt% and Si:0.01 - 2.0 wt%, Mn: 0.1 - 3.0 wt% P:0.01 - 0.15wt%, S: Less than 0.010 wt% aluminum:0.001 - 0.05wt% is included. And Cr:0.001 - 2.0 wt% and nickel:0.001 - 2.0 wt%, Any one sort chosen from Cu:0.001 - 2.0 wt% or two sorts or more are contained Mo:0.001 - 2.0 wt%. It consists of Fe and unescapable impurities, and a metal texture is a with a ferritic grain size numbers of 12 or more ferrite single phase organization, the thickness of a surface layer of oxides is 3 micrometers or less, and the board thickness of the remainder is 1.2mm. Ultra-thin hot rolled sheet steel which is excellent in the shock resistance which is the following.

[0012] (4) C:0.0001 - 0.02wt% and Si:0.01 - 2.0 wt%, Mn: 0.1 - 3.0 wt% P:0.01 - 0.15wt%, S: Less than 0.010 wt% aluminum:0.001 - 0.05wt% is included. And B:0.0001 - 0.01wt% and Ti:0.001 - 2.0 wt%, Any one sort chosen from Nb:0.0005 - 1.0 wt% or two sorts or more are contained. Furthermore, Cr:0.001 - 2.0 wt% and nickel:0.001 - 2.0 wt%, Any one sort chosen from Cu:0.001 - 2.0 wt% or two sorts or more are contained Mo:0.001 - 2.0 wt%. It consists of Fe and unescapable impurities, and a metal texture is a with a ferritic grain size numbers of 12 or more ferrite single phase organization, the thickness of a surface layer of oxides is 3 micrometers or less, and the board thickness of the remainder is 1.2mm. Ultra-thin hot rolled sheet steel which is excellent in the shock resistance which is the following.

[0013] (5) Above (1) - (4) In any one manufacturing the ultra-thin hot rolled sheet steel of a description The steel stock of the component composition indicated to each is heated at 900-1250 degrees C. It joins to a sheet bar, and nothing and the sheet bar which subsequently precedes this sheet bar by rough rolling. Rolling speed 900 m/min They are 1.2mm of board thickness above, carrying out lubrication on rolling-complete-temperature Ar3 transformation point - (+50 degrees C of Ar3 transformation points), and the conditions of 95% or more of rolling reduction. Finish rolling is carried

out to the following. After that 0.5 It is the cooling rate of 50 degrees C/sec within a second. The manufacture method of the ultra-thin hot rolled sheet steel characterized by cooling below to 450 ** above, and rolling round in a coil.

[0014]

[Mode for carrying out the invention]

(1) Explain hereafter the Reason which limited the chemical entity of steel as mentioned above in this invention.

C: Although the thing which is the index of press-forming nature and which it is extended and is made to decrease from a viewpoint of improvement in an r value is desirable, 0.0001-0.02wt%C brings about degradation of the Taiji following processing brittleness, or the strength reduction of a weld zone and is not desirable unless it fills the content to 0.0001wt%. They are Ti for C immobilization for on the other hand, making it ferrite single phase, when C content exceeds 0.02wt%, and Nb. It must add superfluously and is not desirable. therefore, C content -- 0.0001 - 0.02wt% -- it is preferably considered as 0.0003 - 0.008 wt% of the range.

[0015] Si: Although 0.01-2.0 wt%Si should just carry out required quantity addition according to a target intensity level, if it adds exceeding 2.0wt %, a steel plate will harden, and moldability will fall, and also surface treatment nature deteriorates notably. Therefore, the maximum of a Si content is made into 2.0 wt%. Moreover, since manufacture cost goes up to consider it as less than [0.01wt%], a minimum is made into 0.01wt%.

[0016] Mn: Although 0.1 -3.0 wt%Mn has the desirable thing which is the index of press-forming nature and which it is extended and is made to decrease from a viewpoint of improvement in an r value, when less than 0.1 wt%, strengthening effect sufficient as a charge of automobile material is not acquired. On the other hand, if it adds exceeding 3.0 wt%, a steel plate will harden remarkably and moldability will fall. therefore, a Mn content -- 0.1 - 3.0 wt% -- it is preferably considered as 0.3 - 1.5 wt% of the range.

[0017] P: Even if 0.01-0.15wt%P is an element useful to strengthening of steel and it is small 0.01 wt% needs to be added. On the other hand, it is 0.15. If it adds exceeding wt%, a hot-rolling motherboard will be stiffened notably, and the fall of moldability will be caused, and surface treatment nature will also be degraded notably. Therefore, the maximum of the content of P is made into 0.15wt%.

[0018] S: By reducing the content, the sludge in steel decreases in number and workability of less than 0.010 wt%S improves. Such an effect is acquired by making the amount of S less than 0.010 wt%. In addition, since manufacture cost starts considering it as less than [0.0001wt%] very much, as for a minimum, stopping to about 0.0001wt% is desirable.

[0019] aluminum: Although 0.001 -0.05wt%aluminum improves workability by addition not more than 0.05wt%, if it becomes less than [0.001 wt%], inclusion will increase and it will reduce workability in connection with it. Therefore, let content of aluminum be 0.001 - 0.05wt% of a range.

[0020] B: 0.0001-0.01wt%B is an element useful for raising secondary elaboration-proof brittleness, and the effect shows up in addition beyond 0.0001wt%. since the effect will be saturated on the other

hand if it adds exceeding 0.01wt% -- 0.0001 - 0.01wt% -- it is preferably considered as the range of 0.0002-0.0020.

[0021] Although Ti:0.001 -2.0 wt%Ti is an element useful to an improvement of moldability and the effect shows up in addition beyond 0.01wt% 2.0 since the effect is saturated and causes the rise of manufacture cost, even if it adds exceeding wt% -- 0.01 - 2.0 wt% -- desirable -- 0.01-1.5 It is considered as the range.

[0022] Nb: 0.0005-1.0 wt%Nb is an element which makes rolling distortion easy to raise the recrystallizing temperature of austenite and to accumulate into austenite, and makes a ferrite grain size fine. the effect since the effect is saturated even if it adds exceeding 1.0 wt% although it appears in addition beyond 0.0001 wt% -- 0.0001 - 1.0 wt% -- desirable -- 0.001-0.1 It is considered as the range.

[0023] Cr: 0.001 -2.0 wt%Cr is an element useful to strengthening of steel, and should just carry out required quantity addition according to a target intensity level. Although the effect shows up by addition beyond 0.001 wt%, it is saturated even if it adds exceeding 2.0 wt%, and manufacture cost also becomes high. therefore, the content of Cr -- 0.001 - 2.0 wt% -- desirable -- 0.01-1.0 It is considered as the range.

[0024] nickel: 0.001 - 2.0 wt%, nickel is an element useful to strengthening of steel, and should just carry out required quantity addition according to a target intensity level. Although the effect shows up by addition beyond 0.001 wt%, it is saturated even if it adds exceeding 2.0 wt%, and manufacture cost also becomes high. therefore, the content of nickel -- 0.001 - 2.0 wt% -- desirable -- 0.01-1.0 It is considered as the range.

[0025] Mo: 0.001 -2.0 wt%Mo is an element useful to strengthening of steel, and should just carry out required quantity addition according to a target intensity level. Although the effect shows up by addition beyond 0.001 wt%, it is saturated even if it adds exceeding 2.0 wt%, and manufacture cost also becomes high. therefore, the content of Mo -- 0.001 - 2.0 wt% -- desirable -- 0.01-1.0 It is considered as the range.

[0026] Cu : 0.001 -2.0 wt%Cu is an element useful to strengthening of steel, and should just carry out required quantity addition according to a target intensity level. Although the effect shows up by addition beyond 0.001 wt%, it is saturated even if it adds exceeding 2.0 wt%, and manufacture cost also becomes high. therefore, the content of Cu -- 0.001 - 2.0 wt% -- desirable -- 0.01-1.0 It is considered as the range.

[0027] (2) In the ultra-thin hot rolled sheet steel concerning this invention, as mentioned above, it is a with a ferritic grain size numbers of 12 or more ferrite single phase organization about a metal texture, and the thickness of a surface layer of oxides needs to be 3 micrometers or less. This is because it is necessary to consider a metal texture as a ferrite single phase organization first in order to secure the outstanding hole expansion property. Moreover, a ferritic grain size number is made or more into 12 because the fall of dynamic strength will be caused and sufficient shock resistance will not be obtained, if it becomes less than 12 grit. The influence of the ferritic grain size number exerted on the absorbed energy for which it asked from the elongation-stress curve at the time of the high strain rate

(strain rate 103 (s-1)) **** modification used for drawing 1 as a shock-proof index is shown. It is the value which defines the above-mentioned absorbed energy here at drawing 2. In addition, the manufacture conditions of drawing 1 are later mentioned in the work example. [that furthermore, the layer-of-oxides thickness of a steel sheet surface shall be 3 micrometers or less] It is required for surface layer-of-oxides thickness to be 3 micrometers or less, in order to decide the productivity of an ultra-thin steel plate by pickling speed which removes the layer of oxides of a steel sheet surface and to attain a high throughput, Moreover, when processing it without carrying out pickling, there is almost no exfoliation of a layer of oxides, and it is because it is advantageous to the shock resistance after fabrication.

[0028] (3) [next, the ultra-thin hot rolled sheet steel concerning this invention] Heat steel slab at 900-1250 degrees C, and by rough rolling A sheet bar and nothing, Subsequently, it joins to the sheet bar which precedes this sheet bar, and is rolling speed 900 m/min. Above, They are 1.2mm of board thickness, carrying out lubrication on rolling-complete-temperature Ar3 transformation point - (+50 degrees C of Ar3 transformation points), and the conditions of 95% or more of rolling reduction. Finish rolling is carried out to the following and it is 0.5 after that. It is the cooling rate of 50 degrees C/sec within a second. It cools below to 450 ** above, and is manufactured by rolling round in a coil. Each manufacture conditions are explained below.

[0029] - Rolling cooking temperature rolling cooking temperature cannot perform finish rolling temperature at the temperature of three or more transformation points of Ar(s), but serves as ferrite region rolling, and becomes a big and rough crystal grain, and it becomes impossible to make a ferritic grain size number 12 or more under by 900 **. When it exceeds 1250 degrees C, the grain size number of a ferrite becomes large and it becomes impossible to, make a ferritic grain size number or more into 12 similarly on the other hand. Therefore, let cooking temperature be the range of 900-1250 degrees C.

[0030] - Carry out rough rolling of the slab heated to the finish rolling above-mentioned temperature span, consider it as a sheet bar, and carry out finish rolling of this sheet bar. At this time, carrying out finish rolling, joining to the sheet bar which precedes a sheet bar, and carrying out lubrication is based on the following Reason. First, lubrication is carried out in order to reduce the increase in the load of the roll accompanying a finish rolling reduction rise. Moreover, as for joining a sheet bar, finish board thickness is 1.2mm of board thickness. The board of the following is for preventing that a board is slippery and efficient rolling cannot be performed, if a board's lenticulating on a hot run table if tension's is not applied in the reduction roll appearance side, and form's worsening, and lubrication are performed. Thus, if it rolls, it will become possible to raise the yield of the tip of the board which was conventionally bad as for the yield, and the back end. Moreover, it is rolling speed 900 m/min It is because to carry out above is required in order to control the amount of temperature drops under rolling and to maintain finish rolling finish temperature at Ar3 transformation-point - (3+50 degrees C of Ar(s)).

[0031] [making finish rolling finish temperature into Ar3 transformation-point - (3+50 degrees C of Ar (s))] It is because rolling complete temperature serves as ferrite region rolling, becomes a big and

rough crystal grain and does not become a with a ferritic grain size numbers of 12 or more fine grain in less than three transformation points of Ar(s). It is because accumulation of the distortion to the austenite grain before metamorphosing into a ferrite will be lacking and the ferrite grain size number after a transformation will not become 12 or more similarly, if (3+50 degrees C of Ar(s)) are exceeded. Moreover, also when finish rolling reduction is less than 95%, 12 or more are not the ferrite grain size number for the same Reason. Therefore, let rolling complete temperature of finish rolling be Ar3 transformation point - (3+50 degrees C of Ar(s)) 95% or more of rolling reduction.

[0032] - It is very important to quench immediately after carrying out finish rolling to the aforementioned board thickness, when rolling round with cooling after rolling and controlling the ferrite crystal grain diameter in the ultra-thin steel plate of under board thickness 1.2 mm. After termination of finish rolling, and 0.5 It is the cooling rate of 50 degrees C/sec within a second. [cooling below to 450 ** above] 0.5 after termination of rolling Distortion stored into austenite when it cooled radiationally until it exceeded the second is opened wide. It is because a predetermined ferrite grain size cannot be obtained, and a cooling rate is 50-/sec. It is because it becomes impossible to obtain a predetermined ferrite grain size for the Reason nil why the following is also the same. Furthermore, it is because big and rough-ization of a ferrite grain is caused and a predetermined ferrite grain size cannot be obtained, if shut down cooling temperature exceeds 450 **. In addition, when shut down cooling temperature is low to remainder, uniform cooling is difficult, and since dispersion in the quality of the material becomes large, it is desirable [the minimum] to consider it as 300 **. In addition, also in order to control the layer-of-oxides (scale) thickness of a steel sheet surface to 3 micrometers or less, it is 0.5 after termination of finish rolling especially. It is the cooling rate of 50 degrees C/sec within a second. It is effective to cool below to 450 ** above.

[0033] In addition, the effect in the ultra-thin hot rolled sheet steel by this invention can give this similarly in the surface treated steel sheet made from. Moreover, although the above explanation described the business for cars chiefly, it cannot be overemphasized that the technology by this invention is effective like other uses of which the intensity under a high strain rate is required.

[0034]

[Working example]

- Steel of the chemical composition shown in the work-example table 1 was ingoted with the converter. Heat the slab of these components with the monograph affair shown in Table 2, perform rough rolling, and it is considered as a 25-35mm sheet bar. Subsequently, it joined to the sheet bar which precedes this sheet bar, and finish rolling was carried out, carrying out lubrication (lubricating oil use) with the rolling speed, rolling complete temperature, and rolling reduction of a monograph affair, and it was considered as the ultra-thin steel plate of board thickness shown in Table 3 through cooling and rolling up.

[0035]

[Table 1]

成分組成 (wt%)													備考
No	C	Si	Mn	P	S	Al	Ti	Nb	B	Cr	Ni	Mo	Cu	
1	0.005	0.087	0.98	0.04	0.004	0.04	—	—	—					発明例
2	0.003	0.55	1.5	0.031	0.008	0.04	0.038	—	0.002					〃
3	0.003	0.51	0.57	0.08	0.004	0.036	—	0.002	0.005					〃
4	0.004	0.97	0.29	0.024	0.009	0.04	0.047	0.002	0.0012					〃
5	0.005	1.58	1.34	0.12	0.004	0.04	—	0.008	—					〃
6	0.013	1.43	1.5	0.142	0.004	0.035	0.046	0.01	0.009			0.8		〃
7	0.0033	0.27	0.84	0.02	0.006	0.05	0.061	0.05	0.005	0.2		0.1		〃
8	0.003	0.49	0.51	0.052	0.005	0.038	0.083	0.002	0.005		0.5			〃
9	0.005	1.17	1.44	0.057	0.004	0.035	0.031	0.002	0.004				1.0	〃
10	0.0009	0.31	0.48	0.004	0.005	0.039	—	—	0.001					比較例
11	0.002	0.91	1.02	0.095	0.004	0.041	0.013	0.005	0.007					〃
12	0.005	0.30	0.62	0.03	0.005	0.039	0.050	—	0.002					〃
13	0.003	0.12	0.73	0.04	0.004	0.042	—	—	—		0.3			〃

[0036]

[Table 2]

No	加熱温度 (℃)	Ar_3変態点 (℃)	圧延終了温度 (℃)	仕上圧延速度 (m/sec)	仕上圧延圧下率 (%)	冷却開始時間 (sec)	冷却速度 (℃/sec	冷却停止温度 (℃)	備考
1	1200	712.2	735	950	96.1	0.1	127	418	発明例
2	950	688.9	720	980	96.1	0.2	105	362	〃
3	1240	845.4	879	1000	96.1	0.2	99	406	〃
4	1150	909.1	920	980	96.2	0.2	110	412	〃
5	1100	772.6	792	950	96.7	0.2	92	373	〃
6	920	818.4	835	950	96.7	0.1	86	370	〃
7	1050	749.9	768	920	97.0	0.2	73	321	〃
8	970	841.1	889	1000	96.2	0.2	58	391	〃
9	1100	768.0	795	930	96.2	0.2	58	383	〃
10	850	808.9	795	960	96.2	1.0	76	351	比較例
11	1200	821.91	876	940	96.2	1.0	66	426	〃
12	1150	835.2	853	920	90.6	0.4	54	438	〃
13	1120	842.61	876	930	95.8	0.3	23	523	〃

[0037] While performing texture observation about the central position in the thickness direction of these obtained hot rolled sheet steel and measuring the ferrite grain size (JIS), the thickness of the layer of oxides of a steel sheet surface was measured with the organization photograph. Moreover, a test piece for tensile test 5mm in width of a parallel part and 10mm in length is extracted from these obtained hot rolled sheet steel, and a strain rate is 103 (s-1). 10-3 (s-1) The tension test was done

and it asked for the static-dynamic ratio from each yield stress. Moreover, it asked for the absorbed energy to the 30% distortion at the time (strain rate 103 (s-1)), and the absorbed energy to a fracture according to the definition of drawing 2 . Furthermore, the rate of hole breadth was measured and it was considered as the index of elongation flange nature. These measured characteristics values are shown in Table 3.

[0038]

[Table 3]

No	フェライト粒度番号 (℃)	板 厚 (mm)	静的降伏応力 (kgf/mm²)	動的降伏応力 (kgf/mm²)	静動比	動的吸収エネルギー 30%歪 (MJ/m³)	動的吸収エネルギー 破断 (MJ/m³)	酸化層厚さ (μm)	穴拡がり率 (%)	備 考
1	13	1.18	28.4	47.6	1.68	207	330	1.4	84	発明例
2	12	1.17	39.4	65.1	1.65	221	342	1.2	82	〃
3	14	1.17	32.2	54.8	1.70	216	338	2.1	80	〃
4	15	1.15	28.6	47.2	1.65	208	331	2.3	80	〃
5	18	1.00	49.9	87.1	1.75	234	352	1.4	76	〃
6	17	1.00	45.9	82.0	1.79	224	340	1.9	75	〃
7	19	0.91	32.5	62.1	1.91	209	324	2.2	83	〃
8	14	1.13	33.8	58.6	1.73	204	327	2.7	82	〃
9	16	1.13	44.9	78.3	1.74	218	348	2.4	76	〃
10	9	1.15	26.1	39.2	1.50	181	280	2.6	80	比較例
11	11	1.15	40.6	62.7	1.54	192	291	2.8	76	〃
12	9	1.32	30.3	47.3	1.56	185	280	2.3	74	〃
13	10	1.18	31.8	49.2	1.55	190	287	3.9	70	〃

[0039] By this invention method, the ferritic grain size number has manufactured each with the yield sufficient [an ultra-thin steel plate with good form] or more by 12. The static-dynamic ratio of the characteristics is 1.6 so that clearly from the result shown in Table 3. It is above. The absorbed energy to 30% distortion is 200 MJ/m3. The absorbed energy to the above or a fracture is 320 MJ/m3. It turns out that it has the shock resistance which was excellent in more than, and the hole spread rate moreover also has 75% or more of good elongation flange nature.

[0040]

[Effect of the Invention] As explained above, according to this invention, it becomes possible to manufacture the ultra-thin hot rolled sheet steel which was excellent in the static-dynamic ratio conventionally, and was excellent also in forming processing of elongation flange nature etc. by making it the ferrite which the chemical composition, the scale thickness, and the grain size number of the steel plate controlled proper. And according to this invention method, since it is stabilized with the sufficient yield and this steel plate can be manufactured, productivity can also be improved, and manufacture of inexpensive hot rolled sheet steel is attained. Therefore, it becomes possible to attain much more economically the weight saving of the automobile body, and improvement in safety,

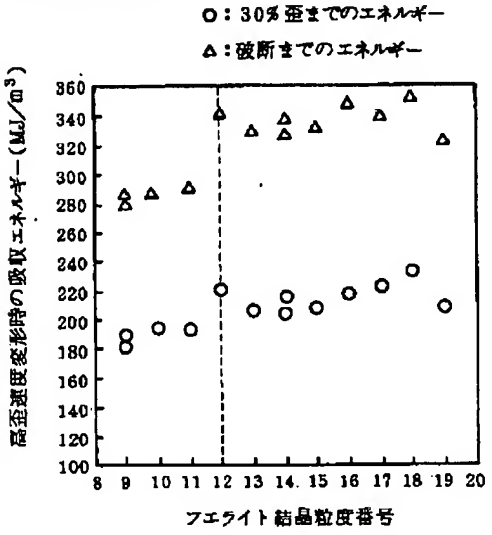
without spoiling press-forming nature by applying the ultra-thin hot rolled sheet steel according to this invention to cars.

[Brief Description of the Drawings]

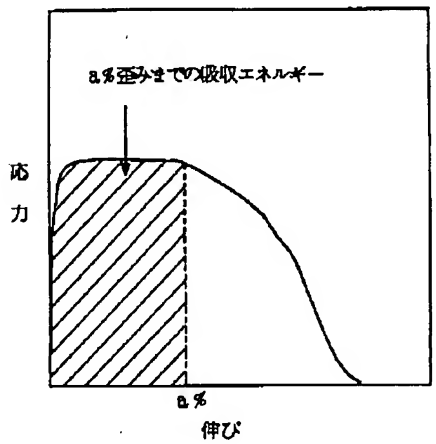
[Drawing 1] It is the figure showing the relation between the absorbed energy at the time of high distortion speed modification, and a ferritic grain size number.

[Drawing 2] It is the figure which defines the absorbed energy at the time of high distortion speed modification.

[Drawing 1]



[Drawing 2]



[Translation done.]